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ABSTRACT

The purpose of this study was to investigate how AC Project (a national service project funded by the U.S. government) members interacted with and perceived a CD-ROM-based instructional program on interactive writing integrated into their training context as a supplementary tool. The theory of constructivism was examined to frame the theoretical foundation of this study. A qualitative case study approach was employed and data were collected through video/audio tapes, questionnaires, follow-up interviews, and field notes. Six female AC members of diverse backgrounds were recruited on a voluntary basis. Major findings reveal that: participants felt they situated themselves in an authentic learning environment that engaged them in a meaningful learning situation; and the CD-ROM was perceived to be a very interesting, appropriate, useful, helpful, and good supplementary medium to adapt to heterogeneous learners' learning styles, needs, situations, expectations, and previous computer experiences. Discussions of findings concerning learning from constructivist viewpoints and human-machine interactions are presented. Contains 20 references. (Author/DLS)

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A QUALITATIVE STUDY OF LEARNERS' USE OF AN INSTRUCTIONAL MULTI/HYPERMEDIA PROGRAM IN AN EDUCATIONAL TRAINING ENVIRONMENT

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Abstract The purpose of this study was to investigate how AC members interacted with and perceived a CD-ROM-based instructional program integrated in their training context as a supplementary tool. The theory of constructivism was examined to frame the theoretical foundation of this study. A qualitative case-study approach was employed and data were collected through video/audio tapes, questionnaires, follow-up interviews, and field notes. Six female AC members of diverse background were recruited on a voluntary basis. Major findings of the study reveal that: (a) participants felt they situated themselves in an authentic learning environment that engaged them in a meaningful learning situation; (b) the CD-ROM was perceived to be a very interesting, appropriate, useful, helpful and good supplementary medium to adapt to heterogeneous learners' learning styles, needs, situations, expectations, and previous computer experiences. Discussions of findings concerning learning from constructivist viewpoints and human-machine interactions are presented.

1. INTRODUCTTION

A combination of the state-of-the-art technology and the recently rising learning theory rooted in constructivism makes Vannevar Bush's dream early in 1940s become a reality nowadays [Smith 1988; Marsh & Kumar 1992]. Multi/hypermedia, a merger of text, graphic, animation, video and sound into a computer platform providing information in non-linear formats, is an attempt to provide a learning environment enriched with a wealth of information to allow learners to construct their own knowledge without requiring them to physically leave the environment in which they are working [Marsh & Kumar 1992]. This medium offers more learner control in the learning process than other traditional media presentations [Marchionini 1988]. Moreover, the beauty of interactive multimedia is that it can be designed to provide a variety of paths to learners, making it one of the best media available for dealing with heterogeneous groups of learners [Schwier & Misanchuk 1993].

2. THEORETICAL FRAMEWORK

Technologists' constructivism. Learning theory/psychology has undergone a major revolution during the past few decades [Cooper 1993]. Constructivism is not a completely new approach to learning theory. Most constructivists [Duffy & Jonassen 1992; Bednar, Cunningham, Duffy & Perry 1992; Ertmer & Newby 1993] hold that there is a real world that individuals experience uniquely. Therefore, they argue that meaning is imposed on the world by individuals, rather than existing in the world independently of human beings. Constructivists hold that there are many ways to structure the world and any event or concept should bear many meanings or perspectives. Generally speaking, constructivists do not deny the existence of the real world. The way we know the world is from individual's meaning making, interpretations of our experiences. Since there are many possible meanings to know based on individual experiences, we do not have to strive for a predetermined correct meaning [Duffy & Jonassen 1992; Ertmer & Newby 1993].

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In the constructivist view, learning is an active and constructive process in which the learner builds an internal representation of knowledge from the individual experiences and interactions with the world. This representation of knowledge is constantly open to change [Bednar, Cunningham, Duffy & Perry 1992]. In terms of the constructivist learning approach, learners are encouraged to actively explore complex environments in which knowledge is linked to a context under study and to the experiences that the learners bring to the context. Cunningham points out [Cunningham 1992] that a major difference between objectivists and constructivists is that objectivists expect and require acceptance and closure of a world view, while the constructivist anticipate and encourage debate.

Constructivism and instructional design. The information-rich age and advanced technology capabilities, as identified by [Duffy and Jonassen 1992], have caused us to revisit constructivism, to reconceptualize the learning process and to design new instructional approaches. Cooper states that "changing the learning environment to incorporate a constructivist view adds complexity" [Cooper 1993, p17]. Because constructivists focus on the design of learning environments rather than instructional sequences, designing constructivist learning environments is much more challenging and difficult than designing objectivist instruction.

Jonassen points out that a constructivist design is more process-oriented than product-oriented and accordingly suggests that the design process should be concerned with designing environments which support the construction of knowledge and a meaningful, authentic context for learning and using the knowledge the learner constructs [Jonassen 1994]. Winn says that in order to accommodate instructional design to constructivist environments of learning we require a change in the assumptions about how people learn and about how instructional decisions are made [Winn 1992].

An emphasis on learning rather than on performance and instruction. Under constructivism, learners select their own learning strategies, and their own goals and objectives, unlike traditional instruction in which goals and objectives are set by curriculum developers and instructional designers and thus the learning content and strategy are imposed on the learners from the outside. Consequently, the learner has to assume much of the responsibility for selecting what to learn and how to learn it. The function of the instructional system is to support what the learner decides to do and the role of the teacher becomes a coach or a facilitator.

3. RESEARCH QUESTIONS

The foci of this study were to understand, describe and interpret how AC members interacted with and perceived a CD-ROM-based instructional program on interactive writing. Two sets of questions guided this study: **Question set #1:** How did AC members interact with this CD-ROM-based Instructional Program on Interactive Writing? What were the variations? What factors seemed to account for the variations? **Question set # 2:** How did AC members perceive this CD-ROM-based Instructional Program on Interactive Writing? And how did this change over time? And did they perceive they learned about interactive writing?

4. METHODOLOGY

The methodology here includes background of the study project, research design, the participants, the study site, the procedures of data collection and data analysis.

Background of the research project. A CD-ROM (running on a Macintosh platform) entitled "Interactive Writing" is an interactive hypermedia instructional program developed as a cooperative project between the program of Instructional Design and Technology at a University in the mid-west of

the States and the AC Project [a national service project funded by the U. S. government since 1994] from autumn quarter 1994 through winter quarter 1995. The purpose of the project was to produce an instructional aide which supported the training of AC members who were to learn about interactive writing techniques in 1995 –1996 training settings. The CD-ROM was composed of two major part: "Let me learn about it" which was a slide presentation of detailed information about interactive writing and "Let me try it" which was a simulation of the interactive writing process, designed to allow learners to apply the factual knowledge they gained from the "Let me learn about it" to a real-world-like context with three virtual students."

Research Design. A qualitative case-study approach was employed to obtain a rich, in-depth and holistic account of the research events. Within the postpositivist paradigms [in Lather's term 1991], this study was described as interpretive and descriptive in nature, and utilize a case study method. As Patton points out, "cases illustrate the value of detailed, descriptive data in deepening our understanding of individual variation" [p. 17]. The design was flexible and emergent [Patton 1990].

Participants. Six AC female members were recruited on a voluntary basis and divided into three dyads/cases while they were interacting with the CD-ROM for three times. Their age range was 18 to 37 with a mean of 25 years old. Compared with the other two teams, team one was the oldest team with a mean of 35.5 years old. The age means of teams two and three were very close to each other at 20.5 and 19 years old respectively. Among the six participants, only one of them had already completed her Master's degree while the other five were working on baccalaureate degrees at a state University, four full time and one part time. Their majors were Business Management, ESL, Engineering, Psychology, Physical Therapy, and Management Information Systems.

Study site. The study site was the place where AC trainers conducted their training programs and where the members went to teach the young children. Once the intensive training workshop was completed, all of the members were assigned to three local urban elementary schools in Columbus, Ohio. Since the use of interactive writing program on the CD-ROM was intended to be part of their on-going training process, there was a computer setup in each of the three elementary school's libraries.

Procedures of data collection and analysis. AC training schedule was divided into two phases: a three-week intensive training and an on-going regular training held on every Friday morning. Interactive writing session, given on the first day of AC on-going regular training, was the only session that provided AC members the necessary Interactive Writing techniques. A follow-up questionnaire was administered to the participants right after the session in order to collect the participants' starting experiences and knowledge about the Interactive Writing.

Shortly after the participants had received the interactive writing session in their training, each team started to use the CD-ROM for three times in the following three consecutive weeks. For the purpose of data triangulation, three sets of follow-up questionnaires were used to collect more information and to verify other data each time right after the participants used the CD-ROM. The questionnaires were mainly intended to help them gather their thoughts on the use of this technology and what content they learned from the CD-ROM program.

Several methods such as prolonged engagement, persistent observation, triangulation and thick description, peer debriefing, and member check were used to establish trustworthiness [Lather 1993; Merryfield 1990; Lincoln & Guba 1985] and to legitimate the research project. Reflexive subjectivity on the part of the researcher was continuing throughout the process of data collection and analysis. The data were gathered from the fall quarter of 1995 through winter quarter of 1996 and analyzed from winter through summer quarter of 1996.

The data analysis was guided by the research questions. The analysis evolved around the data reduction, organization, matching, generation of categories and coding as a result of the study of all

data sources. The categorized data eventually assisted the researcher in data interpretation and drawing conclusions.

5. RESULTS

5.1 Major findings related to the first set of questions

Participants felt they situated themselves in an authentic learning environment that engaged them in a meaningful learning situation. Evidence from observations revealed no general pattern in terms of behaviors was found across dyad's interactions with the multi/hypermeida program but some phenomena were observed in their interactions with each section of the computer instructional program. Various factors were identified to account for the multiple variations in behaviors. They were: participants' starting knowledge and experiences with interactive writing; personalities [active, passive, outgoing, or introverted; frustration tolerance levels]; personal learning styles [auditory or visual learners]; personal role [being a mother or a student]; intra-team interactions; comfort levels and familiarity with the computing technology; grade levels of their focus students; and curiosity about the innovative technology.

Additionally, In terms of seat arrangement and mouse manipulation, a pattern was discerned across three teams. The study showed that the participants were more likely to sit on the right side with the mouse if they were more active, comfortable with the operation of the mouse, preferred working individually, or liked to take the leading role in their learning or to control the advancement of the CD-ROM. Otherwise, the participants would like to sit in the left seat if they were shy, introverted, preferred working in pairs, or liked to be guided by their teammates.

Each team took different pathways and learned at its own pace. Each team took different pathways to get through this virtual world. Each participant felt that she learned at her own pace and most of the time she had control over the program except in the mode of "Let me try it" when she got stuck being unable to figure out some meanings of the language in the "Help" mode. It appeared that, most of the time, in the section of "Let me learn about it," each team could make sense out of the meaning of each button and branched to different parts based on their own content knowledge, individual expectations, computer experience and team interactions and decisions.

5.2 Major findings related to the second set of questions

Overall, there was a unanimous agreement among the six participants about the multi/hypermedia program's primary purpose. That is, all of the participants perceived the CD-ROM program to be a very interesting, appropriate, useful, and helpful medium to adapt to heterogeneous learners' individual needs and their learning styles and, further, a good supplementary tool to be used in the AC training program.

The participants expressed that the program refreshed and reinforced their learning about the interactive writing techniques. In addition, the participants pointed out that they experienced some changes in their understanding of interactive writing after they used this CD-ROM several times. Participants constructed different knowledge, and gained in-depth information depending on the individual learning styles, needs, situations, expectations, and previous computer experiences.

6. DISCUSSION OF FINDINGS AND IMPLICATIONS

6.1 Discussion of learning from constructivist viewpoints

This study demonstrates that learning is a matter of individual knowledge construction and meaning making. It confirms the view [Bednar, Cunningham, Duffy, & Perry 1992] that learning is an

active and constructive process in which the learner builds an internal representation of knowledge from the individual experiences and interactions with the world. The way a learner knows the world is from individual meaning making and interpretation of personal experiences.

In addition, the study also supports Zucchermaglio's claim [Zucchermaglio 1993]. Learning with the CD-ROM, evidently, the participants were not merely empty vessels waiting to be filled up with the information from the computer. Instead, they had to actively interact with the screen and with their partners, to make sense out of the interface and language used in the program, then to make a shared decision before they moved forward to the next screens to explore further information.

This study correlates with other researchers' claim [Jonassen, Meyers, & McKillop 1996] that learning with hyper/multimedia requires learners' mindful engagement in the tasks provided by the technologies. Through the capabilities of the technologies and learners' intellectual partnership, the learners will enhance their thinking and learning. The participants showed evidence of being able to enhance their learning through the use of this CD-ROM program. They expressed that they learned more in-depth information which they did not gain from the AC training session and according to the data collected from the questionnaires the information each participant picked up from the technology was not the same. They also experienced changes in their understanding of interactive writing after they used this CD-ROM several times.

6.2 Discussion of human-machine interactions

The participants in this study demonstrated that their path taking was different and at the very beginning they did not use the directional arrow to advance their learning as the designers had intended. In addition, each team had various degrees of difficulty in interacting with the section, "Let me try it", due to being unable to figure out some language employed in the "Help" mode and unable to recognize some button icons. This finding corresponds with a study conducted by [Suchman 1987] concerning how novices interacted with a Xerox machine. Suchman points out although the designer assumes that the preplanned information is clearly and adequately designed and, thus, would be used by the individuals while they are interacting with the system, the predictive model is insensitive to particular circumstances [Suchman 1987]. This is the fundamental problem in human-machine interaction.

As a matter of fact, the users, based on individual prior knowledge, need for exploration, and expectations, have both their own intent, which is not always following the procedural instructions assumed by the designer, and their own way to interpret the information which is made on a moment by moment basis in their particular situations. Suchman observed that "because instructions were sometimes read by the users differently from the way they were actually written on the displays, the reader will find some inconsistencies between sequences and the displays to which they refer" [Suchman 1987, p. 122]. Because language, common sense, and ongoing discussions, etc., will appear contextually related with the procedural information presented on the screen as part of the ongoing activity, Suchman explains that the users/learners, not the predictive model of instructions, will determine their actions through their own interpretation in particular situations. Significantly, the research finding corresponds with Suchman's study. When the participants referred to the "Help" mode in the section of "Let me try it", they interpreted the word "Student" as a "Student's portfolio", while the designers meant a "Student's picture". Their own interpretation suggested that they were to click on the icon of "Student's portfolio" instead of that of the "Student's picture".

While interacting with a program, as Norman points out, usually the users cannot talk directly with the designers, and all communication takes place through the system image, which involves the use of language and symbolic representation [Norman 1990]. If the system image does not make the design model clear plus the user constructs his/her own meaning and knowledge based on his/her prior

experiences and knowledge, then the user's mental model does not match the designer's model. As a result, the user gets stuck. Norman's claim similarly corresponds to Suchman's finding. This study reveals that some participants did run into this type of problem. The participants' mental model, being not identical to the design model, resulted from the user's different meaning construction which, at times, hindered them from further advancement in the program.

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